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| EXAMINER | |
|---|---|
| ANGADI, MAKI A | |
| ART UNIT | PAPER NUMBER |
| 1792 | |

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**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

| Office Action Summary | Application No. | Applicant(s) | |
|---|---|---|---|
| | 10/540,992 | PARK ET AL. | |
| | Examiner | Art Unit | |
| | MAKI A. ANGADI | 1792 | |

*-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --*

**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

1)☒ Responsive to communication(s) filed on *31 August 2009*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

4)☒ Claim(s) *1,6,7,13 and 18-20* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1, 6-7, 13, 18-20* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

**Application Papers**

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

1) ☐ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

## DETAILED ACTION

### *Claim Rejections - 35 USC § 103*

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

1. Claims 1 and 13, are rejected under 35 U.S.C. 103(a) Grover (US Patent No. 5,759,917) and in view of Akahori (EP 1148538).

***As to claim 1,*** Grover discloses a chemical-mechanical-polishing (CMP) slurry composition polishing and ablating an oxide layer selectively in relation to a nitride layer (col.2, lines 21-27), the CMP slurry composition containing ceria polishing particles (col.2, line 34, line 60) with sizes in the range from 10-500 nm with preferred size in the range from 30-300 nm (col.5, lines 6-10) and anionic

dispersing additives (col.6, line 40-45), and the anionic additive serves to control the selection ratio of an oxide layer to nitride layer from 5 to about 100 or more (col.7, lines 9-13).

Grover discloses the use ceria polishing particles but is silent about the particles being polyhedron with grain boundaries larger than 100 nm. However, Akahori discloses the use of ceria abrasive polycrystals (paragraph 0015) comprising 10 nm to 60 nm particle size primary particles as observed by a TEM (paragraph 0044) preferably polycrystals that are aggregates of monocrystals of 5-300 nm (paragraph 0015). It is noted that polycrystals that are a combination of several single crystals with grain boundaries are considered to be polyhedron in structure. The size of the grain boundary of the monocrystals and polycrystalline ceria is dependent on the size of the particles. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to use ceria particles of different structures and grain boundaries in the range 30-300 nm because Akahori illustrates that the addition of polycrystal ceria particles would improve the flatness of the polished surface of a substrate (paragraph 0012) for application in shallow trench isolation without making flaws (paragraph 0057).

Grover discloses the presence of anionic additives (col.6, line 40-45) but is silent about water-soluble polyacrylic acid or water-soluble polycarboxylate in the CMP slurry.

However, Akahori discloses water-soluble polyacrylic acid (paragraphs 0019-0020) in the CMP slurry and the anionic additive from 0.01-2 wt% (paragraph 0026).

Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to select anionic additives in the slurry employed by Grover because Akahori illustrates that anionic additives improve storage stability (paragraph 0011) and flatness of the polished surface of a substrate (paragraph 0012).

***As to claim 13,*** Kido discloses a method of controlling a selection ratio of a CMP slurry and polishing an oxide layer selectively in relation to a nitride layer (paragraph 0011), the method includes the steps that read on: selecting ratio of an oxide layer to a nitride layer of a CMP slurry (paragraph 0026-0027) which include ceria polishing particles (paragraph 0015-0018), dispersing agent (paragraph 0019), concentration of anionic additive is changed (paragraph 0022).

Kido discloses the process of adjusting the concentration of ceria additive to attain a desired selection ratio of the slurry composition on the basis of the polishing-rate selection thereby controlling the selection ratio of the composition (paragraph 0022, Examples 1-23, Table I-III, pages 7-9) but is silent about adjusting the concentration of anionic additive to attain the desired selection ratio. However, Grover discloses the process of adjusting the anionic additive to adjust the selectivity (Tables 3-5, Examples 5-7). Therefore, it would have been obvious to one of ordinary skill in the art at the time the invention was made to adjust the concentration of anionic additive the attain the desired selection ratio

because Grover illustrates that the concentration of anionic additive improves the within-wafer-non-uniformity of the wafers and hence reduce wafer defects (col.6, lines 45-48).

Grover discloses the use ceria polishing particles but is silent about the particles being polyhedron with grain boundaries larger than 100 nm. However, Akahori discloses the use of ceria abrasive polycrystals (paragraph 0015) comprising 10 nm to 60 nm particle size primary particles as observed by a TEM (paragraph 0044) preferably polycrystals that are aggregates of monocrystals of 5-300 nm (paragraph 0015). It is noted that polycrystals that are a combination of several single crystals with grain boundaries are considered to be polyhedron in structure. The size of the grain boundary of the monocrystals and polycrystalline ceria is dependent on the size of the particles. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to use ceria particles of different structures and grain boundaries in the range 30-300 nm because Akahori illustrates that the addition of polycrystal ceria particles would improve the flatness of the polished surface of a substrate (paragraph 0012) for application in shallow trench isolation without making flaws (paragraph 0057).

***Claim Rejections - 35 USC § 103***

2. Claims 18-20 are rejected under 35 U.S.C. 103(a) Grover (US Patent No. 5,759,917) and in view of Akahori (EP 1148538) as applied to claims 1 and 13, in further view of Lee et al. (US Patent No. 6,863,592).

Grover discloses the ceria polishing particles in the range of about 10-300 nm (col.5, lines 3-10) and the use of dispersing agents containing nitrate salts (claims 3-4) e.g. ammonium cerium nitrate (claims 6) but is silent about the use of poly-metha-acrylic ammonium salts. However, Lee discloses the use of dispersing or passivating agents such as poly(acrylic acid, poly(methacrylic acid) (claim 1) and other derivatives. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to employ the use of poly-metha-acrylic ammonium salts as dispersing agents in the slurry composition because Lee illustrates that poly-metha-acrylic ammonium salt as passivating agents in the composition improves the selectivity of CMP slurry (col.2, lines 1-5).

***Claim Rejections - 35 USC § 103***

3. Claims 6, 7 are rejected under 35 U.S.C. 103(a) over Kido (EP 1061111) and in view of Akahori (EP 1148538) and Matthew et al. (WO-96/11082)

***As to claim 6,*** Kido discloses a method for planarizing a surface of a semiconductor device (paragraphs 0001, 0002) that includes steps that read on: preparing a semiconductor substrate (paragraph 0011) in which a level difference nitride layer (3) is formed on the upper surface of the substrate (1) (Fig.1); depositing an oxide layer (5) for filling the level difference and planarizing the surface of the semiconductor substrate so that a predetermined thickness of the oxide layer can be added to surface of the nitride layer (paragraph 0011 and 0028-00230); ablating/polishing the oxide layer by a CMP process using ceria or

other abrasive compositions (paragraph 0025) so as to expose the surface of the nitride layer (Fig.3) (paragraph 0031); CMP process uses CMP slurry that includes ceria polishing particles (paragraphs 0015-0018), a dispersing agent and anionic additive (paragraph 0019-0022) so that a polishing rate selection ratio of oxide layer to nitride layer is 40:1 pr greater (paragraph 0026 and 0033); oxide layer is a silicon oxide layer (2) and the nitride layer is silicon nitride layer (3) (Fig.1, paragraph 0028).

Grover discloses the use ceria polishing particles but is silent about the particles being polyhedron with grain boundaries larger than 100 nm. However, Akahori discloses the use of ceria abrasive polycrystals (paragraph 0015) comprising 10 nm to 60 nm particle size primary particles as observed by a TEM (paragraph 0044) preferably polycrystals that are aggregates of monocrystals of 5-300 nm (paragraph 0015). It is noted that polycrystals that are a combination of several single crystals with grain boundaries are considered to be polyhedron in structure. The size of the grain boundary of the monocrystals and polycrystalline ceria is dependent on the size of the particles. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention was made to use ceria particles of different structures and grain boundaries in the range 30-300 nm because Akahori illustrates that the addition of polycrystal ceria particles would improve the flatness of the polished surface of a substrate (paragraph 0012) for application in shallow trench isolation without making flaws (paragraph 0057).

Kido is silent about the effect of zeta potential on the surface of oxide and nitride layers. However, Matthew discloses the effect of zeta potential on the pH of the aqueous medium as illustrated in Fig.4 (page 7, paragraph 2) and that the zeta potential is a function of the metal oxide composition. Therefore, one who is skilled in the art at the time of the invention was made should be able to control the zeta potential on the surface of oxide and nitride layers because Matthew illustrates in Fig.4 that zeta potential of the composition can be controlled by the addition of salts to the aqueous medium (page 7, paragraph 2) for improved chemical mechanical polishing of metal layers free from undesirable contaminants and surface imperfections (page 3, paragraph 1).

***As to claim 7,*** Kido discloses the level difference is a trench (4) formed on the surface of the semiconductor substrate (1) (Fig.1) (paragraph 0030).

### *Response to Arguments*

4. Applicant's arguments filed on 8/31/2009 have been fully considered but they are not persuasive.

With respect to independent claims 1, 6 and 13, applicants arguments on page 8 of reply asserting that the combined prior art Grover, Akahori, Kido and Matthew do not teach every limitation of these claims are not persuasive. The reference of Grover discloses the use of ceria abrasive in the form of cerium compound (col.3, lines 57-67) but does not explicitly disclose the particles are polyhedron. However, Akahori discloses the use of ceria particles that are

polycrystals with range of particle size as cited in applicants' claims. Akahori discloses that ceria polycrystals range from a few nanometers to several hundred nanometers in size (paragraph 0044). The combined prior art teaches the composition containing abrasive particles with anionic additive, water-soluble polyacrylic acid and therefore meet the limitation of the concentration of the anionic additives and selective polishing the oxide film at high rates (see arguments above on pages 2-4).

***Conclusion***

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure. Tsuchiya (US Patent No. 6, 530,968) discloses CMP slurry.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Maki A. Angadi whose telephone number is 571-272-8213. The examiner can normally be reached on 8 AM to 4.30 PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nadine G. Norton can be reached on 571-272-1465. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Maki A Angadi/
Examiner, Art Unit 1792

/Shamim Ahmed/

Primary Examiner, Art Unit 1792